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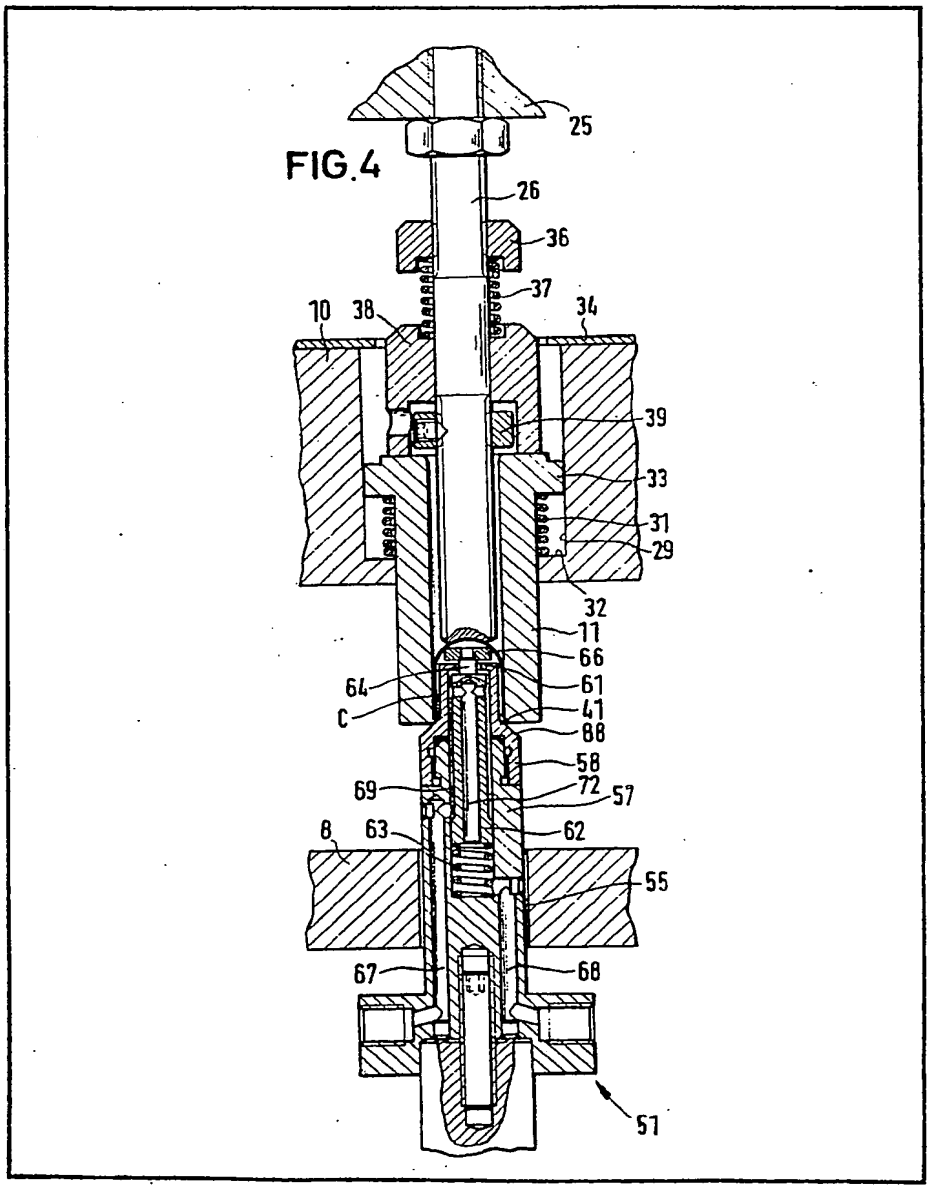
(54) Machine for Connecting Capsule Bodies and Caps

(57) The machine includes a plurality of sleeves 11 for retaining a capsule cap C and associated plungers 51. Within each plunger there is a shaft 62 arranged to reciprocate and carrying at its upper end a plunger head 66 which is biased upwardly by a spring 63. The plunger and plunger head together partially define an annular space adapted to retain sealing fluid or to communicate with a sealing fluid supply via duct 67 when the plunger is urged into contact with the interior of a capsule cap. The machine is constructed so that when the plunger head is depressed by contact with the interior of a cap sealing fluid is applied to the said interior.



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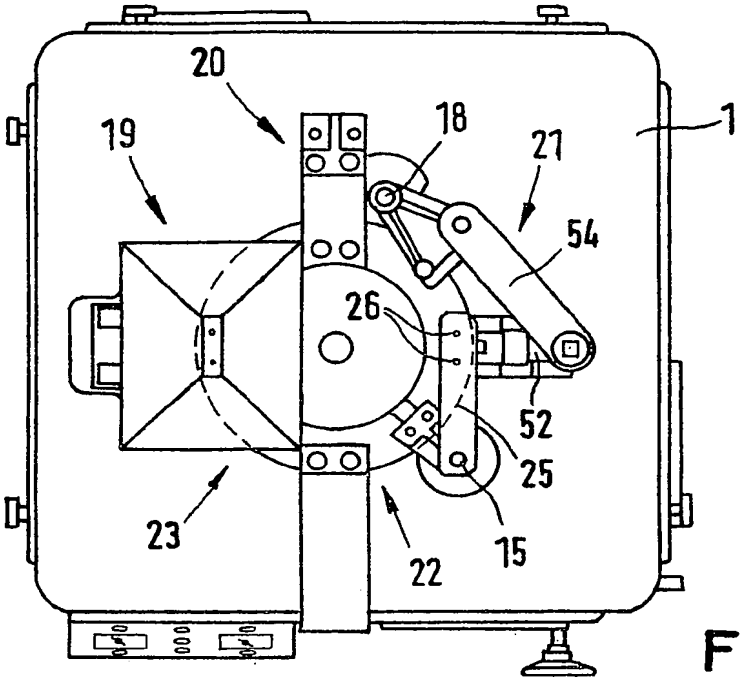

FIG. 1

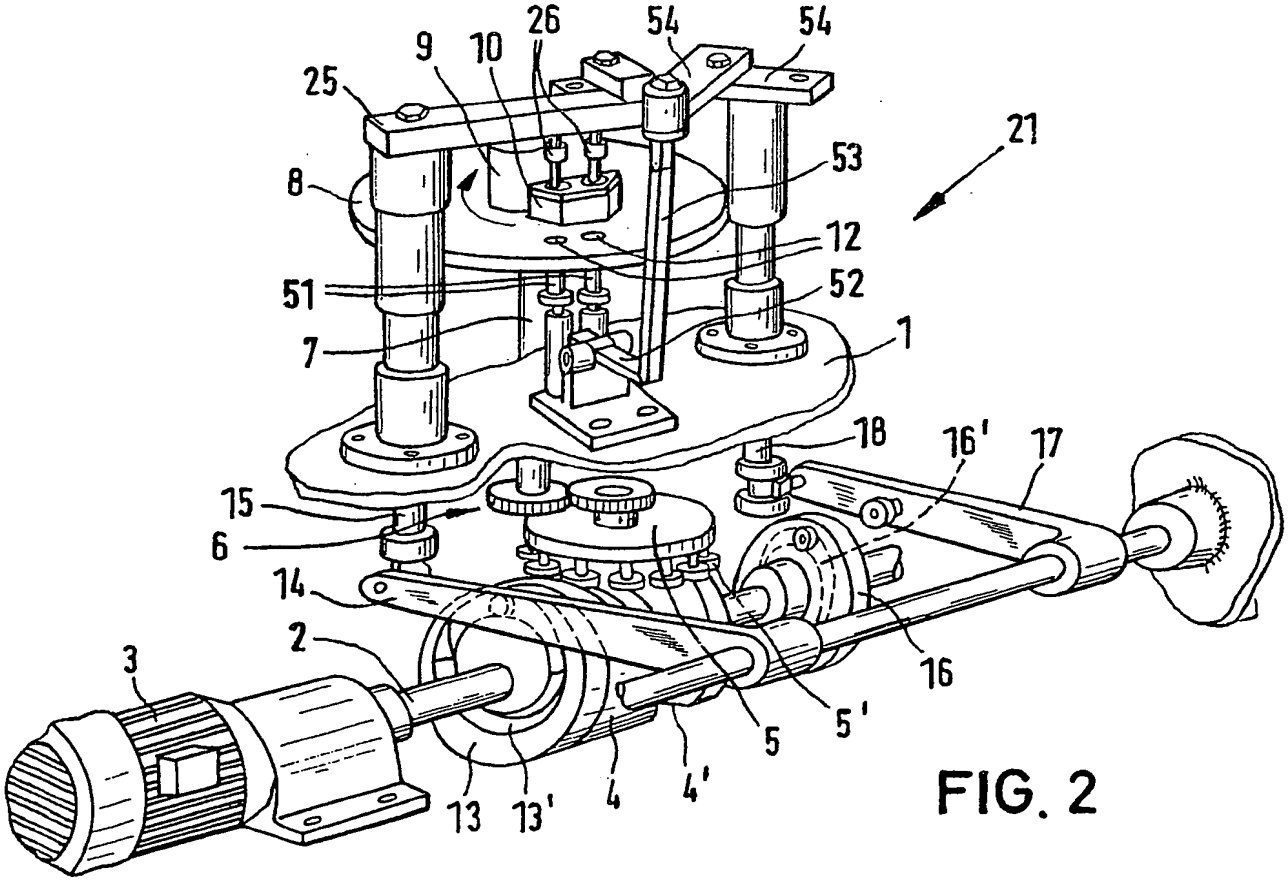

FIG. 2

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FIG. 3

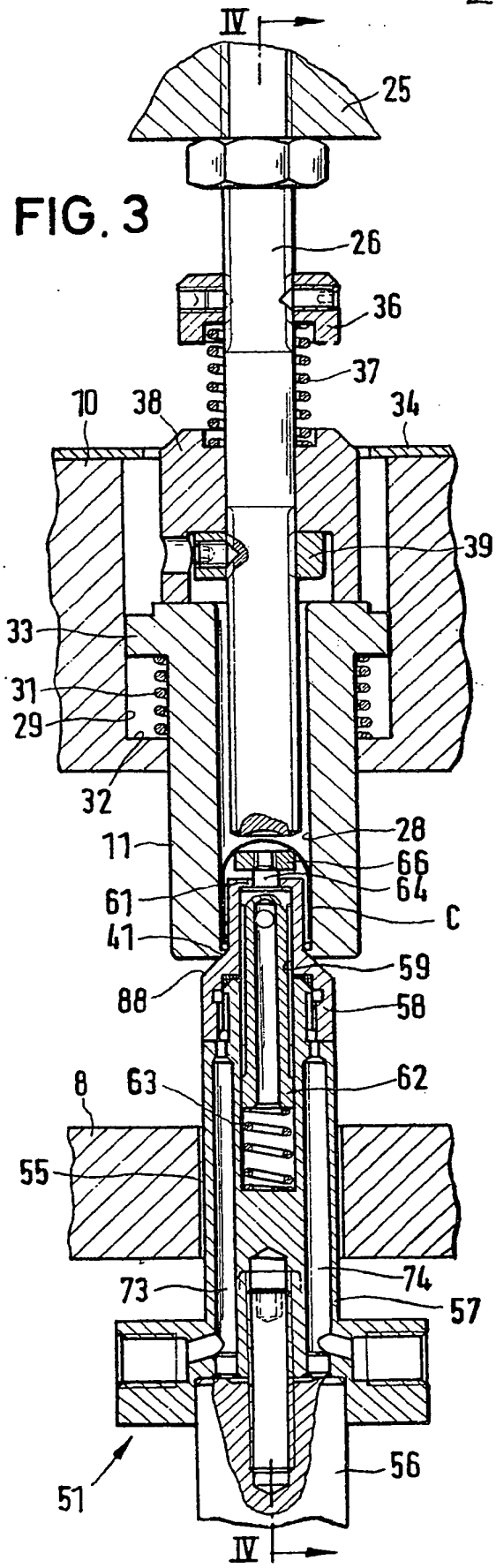


FIG. 4

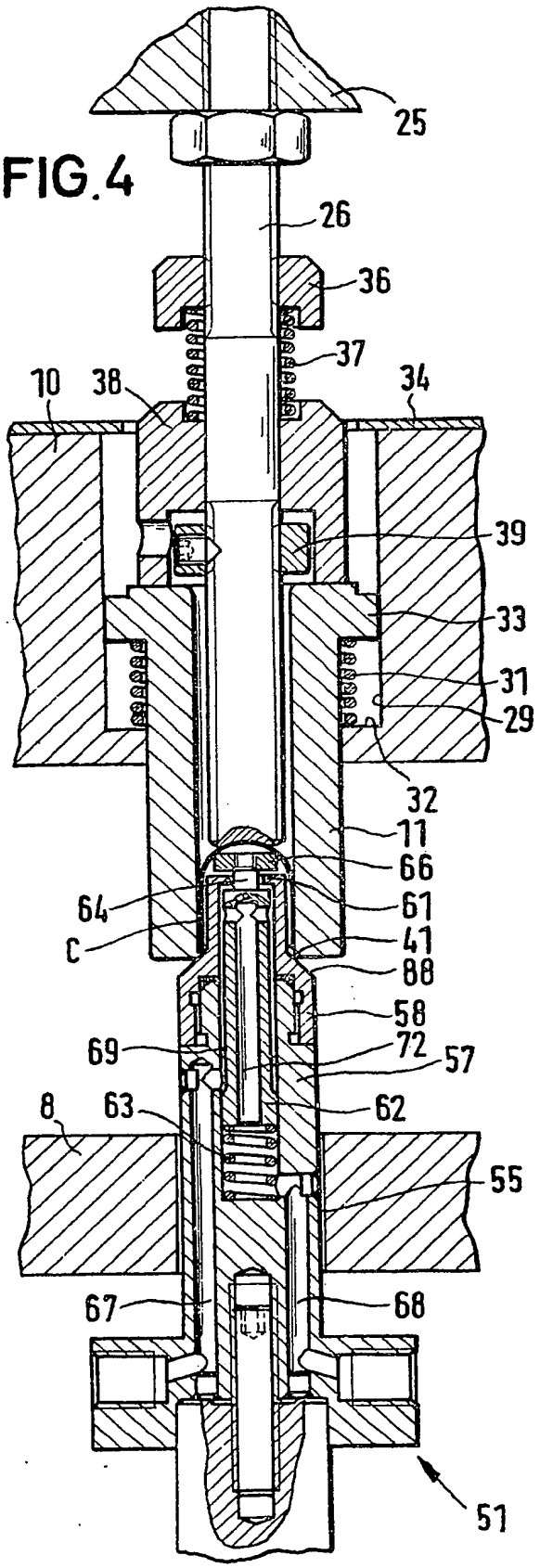


FIG. 5

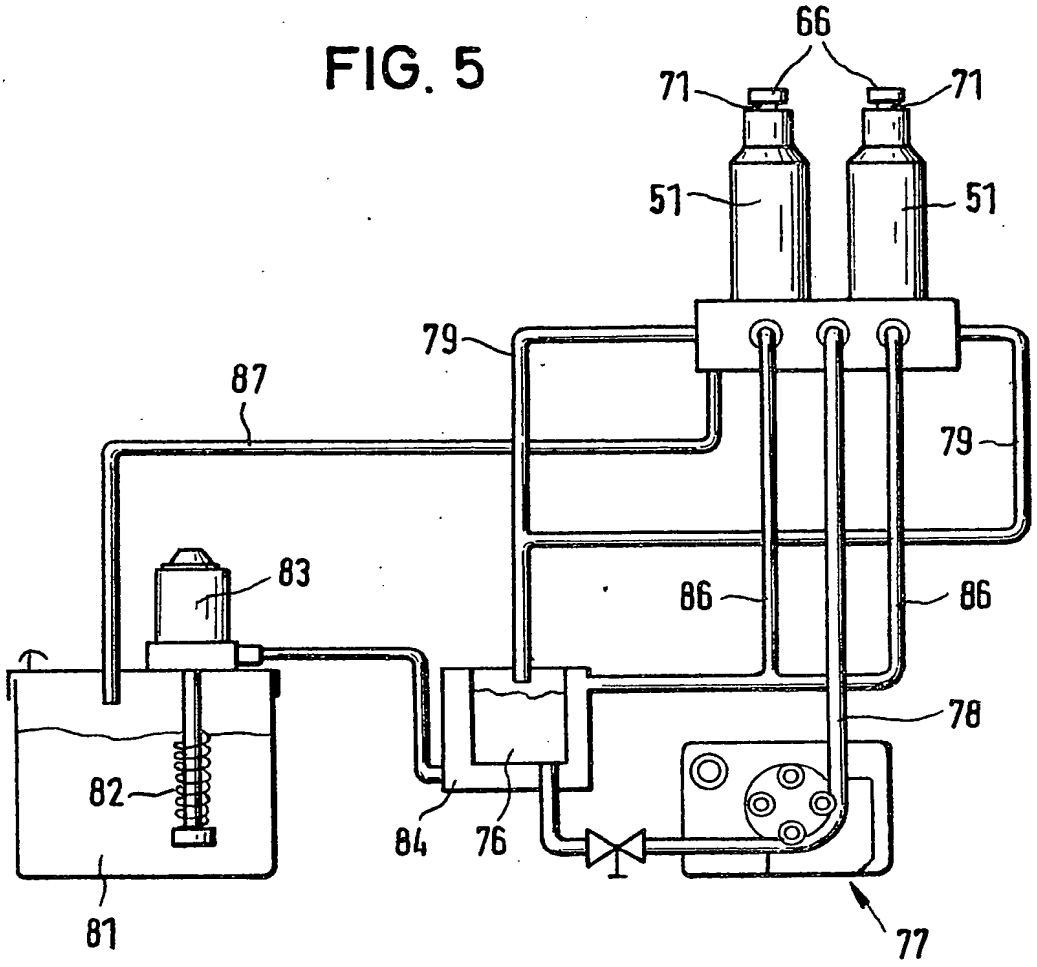
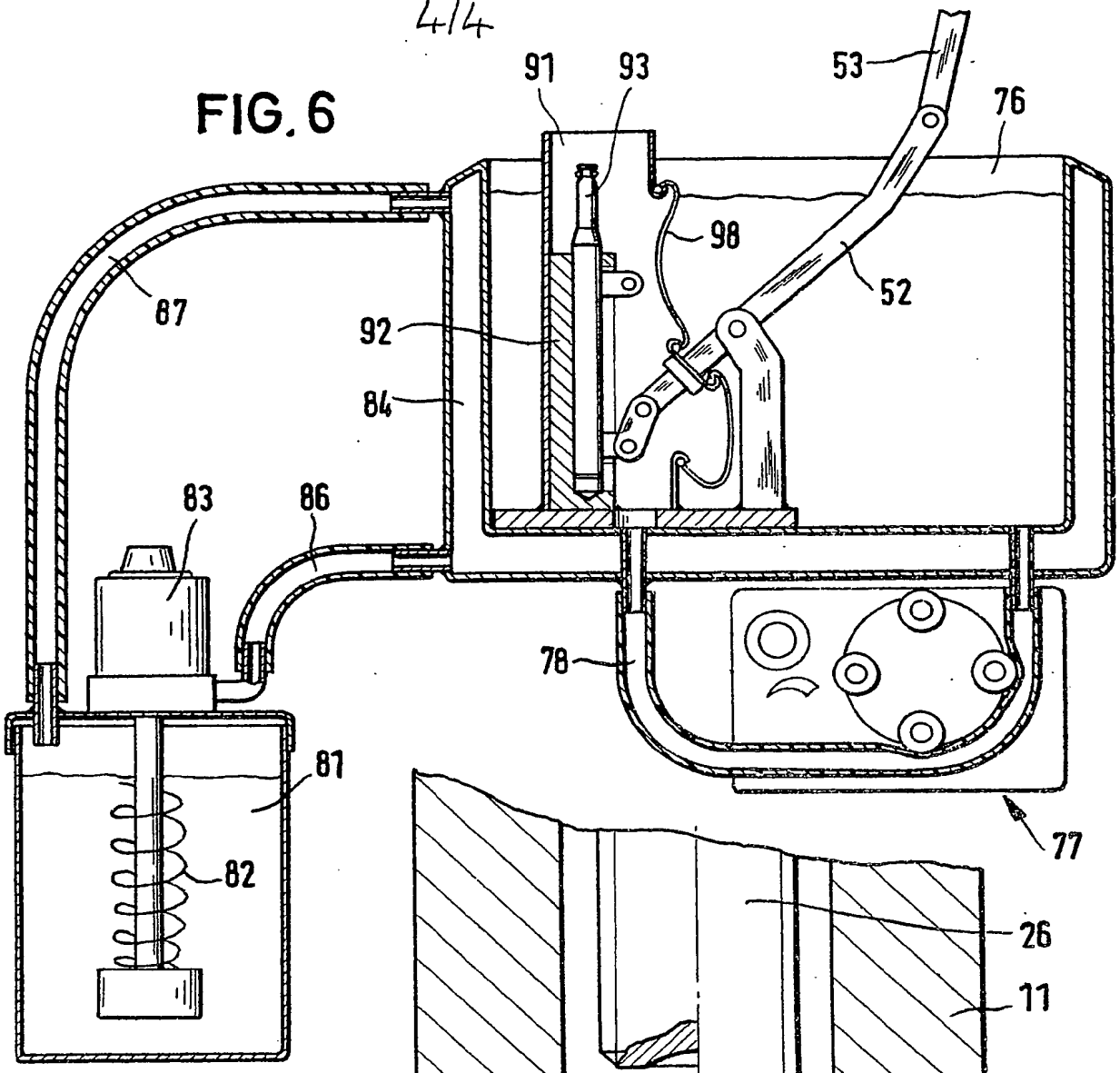


FIG. 6



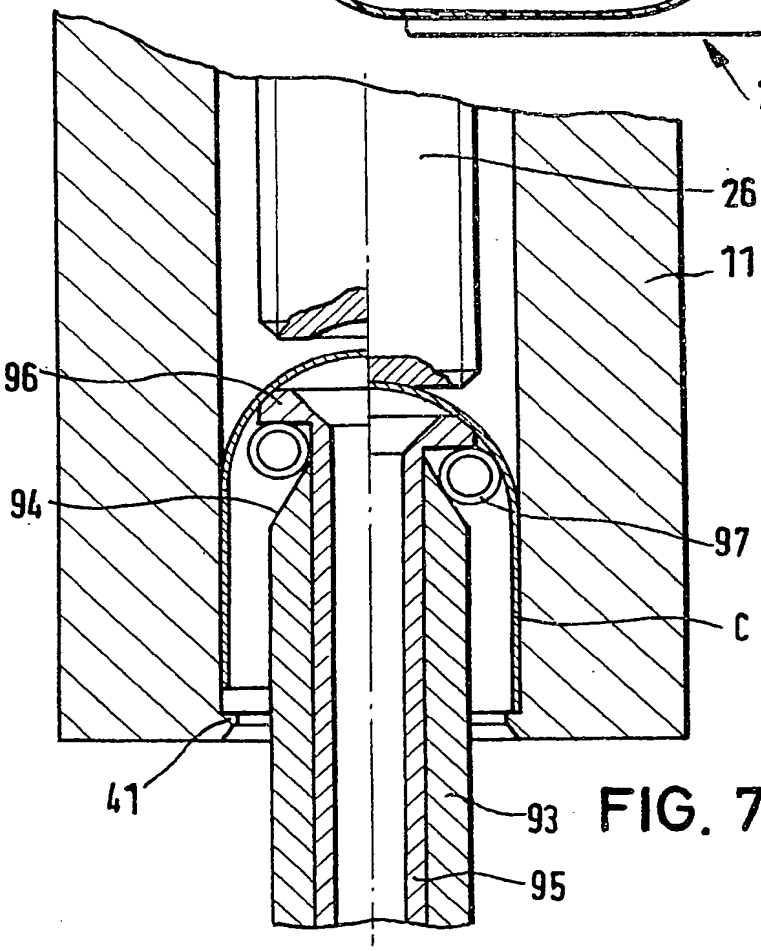


FIG. 7

SPECIFICATION

Machine for Connecting Capsule Bodies and Caps

The invention relates to a machine for connecting capsule bodies and caps, made for instance of hard gelatine, comprising at least one sleeve for receiving and retaining a cap and at least one plunger reciprocable coaxially with respect to the sleeve

In known machines of this type upper, vertical sleeves are arranged in slides which are equispaced about and extend radially outwardly from a turret and are displaceable with respect thereto between a radial inner position and a radial outer position. The turret is rotatable stepwise about a vertical axis by the angular distance between two adjacent slides. A rotary table is arranged below the turret and rotates with it about the same axis and is provided with a number of lower sleeves corresponding to the number of sleeves upper sleeves. When the slides occupy their radial outer positions, the upper sleeves are each disposed vertically above a respective lower sleeve. When the slides occupy their radial inner positions, the lower sleeves are freely accessible from above. When the turret and the rotary table make a complete revolution each pair of sleeves consisting of an upper sleeve and a lower sleeve comes successively to a plurality of stations disposed around the rotary table. The first station comprises an apparatus inserting into the upper sleeve a capsule preliminarily joined by the capsule manufacturer, in such a manner that a collar extending radially inwardly at the lower edge of the upper sleeve extends below the edge of the cap of the said capsule and retains it.

The second station comprises a hollow, lower plunger connected to a source of low-pressure which moves upward from below through the lower sleeve, engages the capsule body by suction, draws the capsule body downwardly away from the cap which remains suspended in the upper sleeve leaving the capsule body in the lower sleeve. On its way to the next station the upper sleeve together with the cap is moved towards the rotary axis of the turret by displacing the associated slide, while the lower sleeve moves below a filling station. The capsule body is filled at the filling station with a metered amount of a flowable or friable filling material. On further rotation of the turrent and the rotary table the slide returns to its radial outer position so that the upper sleeve is again positioned above the lower one. In the next station another lower plunger pushes the capsule body back into the cap while an upper plunger presses against the cap from above. The capsule body as a consequence enters further into the cap than originally so that the capsule body and the cap are fixedly joined. The security of the connection may be increased by the provision of annularly shaped detents provided on the capsule body and on the cap which engage each other. The upper plunger is then withdrawn upwardly and the lower plunger pushes the complete, joined capsule out of the upper sleeve.

Closing machines of this type are successfully employed when the joined capsules are filled with pasty or friable filling material. However, the connection between the capsule body and the cap that can be obtained with known closing machines is not tight enough for highly fluid liquid filling materials.

The invention is therefore directed to the problem of improving a closing machine of the type described such that it is capable of applying a seal to the caps of connected capsules which forms a liquid-tight connection between the cap and capsule body upon the subsequent final joining of the two parts. It is unimportant whether the connected capsules are filled in the usual manner prior to the final connection, or only thereafter, for instance as described in German Patent Application P 27 13 873.4, with the aid of a hollow needle penetrating into the capsule through a hole made by the needle itself or prepared before.

According to the present invention a machine for connecting capsule caps and bodies comprises at least one sleeve for receiving and retaining a cap and at least one plunger reciprocable coaxially with respect to the sleeve, in which the plunger has a plunger head which is axially movable with respect to the plunger and is adapted to fit within a cap, and further includes biassing means adapted to urge the plunger head in a direction which, in use is towards the cap, the plunger head and the plunger together at least partially defining an annular space adapted to retain sealing fluid or to communicate with a supply duct for sealing fluid, the machine being constructed and arranged such that when the plunger head is urged against the interior of a cap sealing fluid is applied to the interior of the cap.

The plunger for applying sealing fluid in accord with the invention may for instance be arranged in the known machine described at that station which is normally the filling station. However it may take the place of another station provided the capsule body is at that point not within the cap and the cap is in a position in which the plunger can be inserted into the cap.

In the preferred embodiment of the invention said plunger head is fixedly secured to a shaft in a bore within the plunger and acted on by a spring.

The shaft may act as a valve member controlling a supply duct for the sealing fluid, the supply duct extending in the plunger and being adapted to communicate with the annular space.

Advantageously the plunger has a first return duct for excessive sealing fluid, the said return duct together with the supply duct forming part of a circulation system for the sealing fluid, the system including a pump and a heatable reservoir. In this manner it can be ensured that inside the plunger fresh sealing fluid is available at all times having the required properties of plurality and viscosity.

In addition the shaft may have a second return

duct communicating with the bore within the plunger adjacent the end of the shaft connected to the first return duct in the plunger at least when the shaft is in a position where the communication of the supply duct with the annular space is interrupted. In this manner it is ensured that fresh sealing fluid is available at all times in the close proximity of the annular space. This reduces the danger that the sealing fluid solidifies on its way to the annular space.

Preferably the plunger includes heating means. This helps to ensure that the sealing fluid, for instance liquid gelatine, exhibits the desired properties in the plunger and hence also in the annular space. An electrical heater may be provided for example. Variations in temperature in the plunger can best be prevented however when the plunger has heating passages communicating with a circulation system for a heating fluid, the system including a pump.

The feature of the invention that the plunger head is fixedly secured to a shaft which is guided in an axial bore in the plunger may be further modified in that an annular, extensible spring adapted to be wetted with sealing fluid is disposed in the annular space, the outer surface being frustoconical so that the spring is pressed radially outwards against the inner wall of said cap when the plunger head is urged against the interior of the cap.

In this embodiment the sealing fluid may be introduced into the annular space through the plunger. When however the plunger is adapted to be moved up and down as is the case with each of the lower plungers of the described known machine, between an upper operating position and a lower rest position, it is possible to wet the spring with sealing fluid by ensuring that, when in its rest position, it is totally immersed in a sealing fluid container. The sealing fluid in the container can easily be maintained at a given temperature and the plunger will have substantially the same temperature since it only has to be raised from the container a relatively short distance in order to urge the spring against the interior of a cap to wet it with the sealing fluid.

Further features and details of the invention will be apparent from the following description of two specific embodiments of the invention which is given by way of example with reference to the accompanying drawings in which:—

Figure 1 is a plan view of a machine for connecting capsule caps and bodies

Figure 2 is a perspective view of parts of the machine;

Figure 3 is an enlarged detail of Figure 2, in vertical section;

Figure 4 is a section on the line IV-IV in Figure 3;

Figure 5 is a schematic representation of the machine shown in Figures 1 to 4;

Figure 6 is a modified construction of the machine shown in Figure 5; and

Figure 7 is an enlarged detail of Figure 6

The illustrated machine is adapted to fill and connect capsules. The capsules consist of a cap C of circular section as illustrated in Figures 3 and 4 and a capsule body having a shape similar to that of cap C but of a smaller diameter and a greater length. The capsules are supplied to the machine in a condition in which the caps C are loosely fitted on the capsule body so that they may be readily separated from each other.

The machine shown in Figures 1 and 2 comprises a base structure 1, on which a horizontal drive shaft 2 is supported. The drive shaft 2 is connected to a geared motor 3 and carries a cam drum 4 having a helical groove 4' formed on its periphery which groove co-operates with rollers 5' on a roller disc 5. The roller disc 5 is supported on the base structure 1 to be rotatable about a vertical axis and is rotated by a predetermined angle of e.g. 45° by the cam drum 4 on each revolution of the drive shaft 2.

The roller disc 5 is connected through a spur gear 6 to a vertical shaft 7 which is also supported on the base structure 1, and a rotary table 8 and above it a turret 9 are mounted on the shaft. A plurality of slides 10, in this case eight, are arranged on the turret 9 so as to be equiangularly spaced. Each of the slides 10 is adapted to be radially reciprocated with respect to the turret 9 between an inner position and an outer position: to this end a drive (not illustrated) is provided which is preferably also connected to the drive shaft 2. Each slide 10 has two adjacent vertical sleeves 11, associated with which are lower sleeves 12 arranged in the rotary table 8 also to be adjacent and vertical. In the radial outer position of each slide 10 the upper sleeves 11 are exactly vertically above the associated lower sleeves 12. All of the structural elements described so far and their function are known in connection with machines for filling and connecting capsules and therefore a more detailed description is considered unnecessary.

A cam disc 13 is mounted on the drive shaft 2 having an eccentric groove 13' in its front face. The groove 13' co-operates with a lug on a lever 14 pivotally mounted on the base structure 1 and carrying a push rod 15 that is vertically guided in the base structure 1. In a similar manner another cam disc 16 mounted on the drive shaft 2 and having an eccentric groove 16' controls a lever 17 carrying another push rod 18 that is vertically guided on the base structure 1.

A number of stations are arranged equiangularly spaced in a manner corresponding to that of the slides 10, around the rotary table 8 and the turret 9, namely a feeding station 19, in which a pair of loosely joined capsules is inserted into the sleeves 11 of a slide 10, a separating station 20, in which the caps C and the capsule bodies are separated from each other, a station (not shown) for filling the capsule bodies, a station 21 for introducing a sealing fluid into the caps C, a closing station 22, in which the capsule bodies and caps are joined again and permanently connected and finally a discharge station 23, in which the connected capsules are ejected from

the sleeves 11. The named stations are all known except for the station 21 for introducing a sealing fluid into the caps C, and are therefore not described in more detail. In the illustrated embodiment, station 21 occupies a position in the known machine that is located between the station for filling and the closing station.

The station 21 for introducing a sealing liquid into the caps C has a traverse 25 secured to the push rod 15, and two plungers 26 vertically depending therefrom. The plungers 26 are spaced apart by a distance equal to the spacing between the two sleeves 11 on each slide 10; consequently the plungers 26, as illustrated in Figures 3 and 4, are adapted to be lowered into the sleeves 11 of whichever slide 10 is at station 21 and occupies its radial inner position. The following details as described are best seen in Figures 3 and 4. Each sleeve 11 has a bore 28 whose diameter corresponds to the outer diameter of the cap C and is considerably larger than the diameter of the lower part of the associated plunger 26.

The slide 10 has a bore 29 having a step 32 for each of its two sleeves 11 in which a respective sleeve 11 is guided so as to be axially displaceable and in which a pressure spring 31 is accommodated bearing against the step 32 and against a flange 33 on the sleeve 11. The spring 31 tends to urge the sleeve 11 in an upward direction against an abutment plate 34 mounted on the slide 10. By lowering the traverse 25 the associated plunger 26 can be inserted into the sleeve 11 and is then in a position to press the sleeve 11 downwardly against the resistance of the spring 31. Figures 3 and 4 show the sleeve 11 partially depressed.

To allow the plunger 26 to exert a gradually increasing, downwardly directed force on the sleeve 11, during a downward movement of the traverse 25 a thrust ring 36 is screwed on the upper part of the plunger 26 and is secured there in a selectable position against undesired rotation. A pressure spring 37 bears against the thrust ring 36 and against a bushing 38 guided on the centre part of the plunger 26 so as to be axially slidable. The bushing 38 is hollow at its lower end and encloses another thrust ring 39 screwed onto the plunger 26 from below and similarly secured in a selectable position against undesired rotation. Normally, the spring 37 serves to bring the bushing 38 into abutment with the thrust ring 39 as shown in Figure 3. If the plunger 26 is pressed downwardly beyond the position shown in Figure 3, the increasing resistance of the spring 31 retards the sleeve 11, while the spring 37 is compressed further so that the further downward movement of the plunger 26 is a relative movement with respect to the sleeve 11; this relative movement is limited in that the thrust ring 39 abuts eventually against the upper end of the sleeve 11.

The sleeve 11 has at its lower end an inwardly projecting collar 41 constricting its bore 28 which prevents a cap C inserted in the bore 28 from falling out unintentionally. This collar 41 allows on the one hand the capsule body to be withdrawn from the cap C in the separating station 20, and on the other hand a sealing fluid to be introduced into the cap C at station 21, the collar 41 acting as an abutment allowing plunger 26 to bring the cap C into an exactly defined position within the sleeve 11 as shown in Figure 4.

The station 21 for introducing a sealing fluid further includes two lower plungers 51 guided so as to be vertically displaceable on the base structure 1 below the rotary table 8, which plungers are linked with a rocker 52 mounted on the base structure 1. The rocker 52 is connected through a linkage 53 to a traverse 54 which is secured to the push rod 18; the rocker 52 being provided to reverse the direction of movement of the push rod 18 so that the lower plungers 51 move in a direction that is opposed to the direction of movement of the upper plungers 26. The reversal of the direction of motion of the push rod may be achieved in many ways, for instance by modifying the cam disc 16; however in the illustrated embodiment it was intended to make as few changes as possible to a conventional machine.

The lower plungers 51 are offset radially inwardly with respect to the lower sleeves 12 secured to the rotary table 8 and are in alignment with the sleeves 11 of the slide 10 when it is in its inner position at station 21. In order to enable the two lower plungers 51 to be inserted from below into the two upper sleeves 11 when the rotary table 8 and the turret 9 come to rest the rotary table 8 is provided with apertures 55 vertically below the positions that are occupied by the sleeves 11 when the slide carrying them is in the radial inner position.

Each of the plungers 51 has a lower part 56 bearing against the rocker 52, a centre part 57 screwed thereto and an upper part 58 screwed to the centre part. The centre part 57 and the upper part 58 have a bore 59 constricted at the upper end of the upper part 58 by a collar 61. A shaft 62 is guided so as to be axially displaceable in the bore 59, and a pressure spring 63 is arranged within the bore tending to urge the shaft 62 upwardly against the collar 61. The shaft 62 has a pin 64 having a diameter less than the internal diameter of the collar 61, extending upwardly through the collar 61 and screwed to a plunger head 66.

As seen in Figure 3 the centre part 57 of the plunger 51 has a supply duct 67 and a return duct 68 for a sealing fluid. Above these ducts are longitudinal grooves 69 in the shaft 62 through which the sealing fluid may flow up to the collar 61 and when the plunger 51 is in the position illustrated it may flow further into an annular space 71 (seen in Figure 5) between the collar 61 and the plunger head 66 and thence to the inner wall of the cap C. Shortly below the collar 61 a return duct 72 formed in the shaft 62

commences, which duct communicates with the return duct 68.

Centre part 57 and upper part 58 of the plunger 51 further have supply passages 73 and return passages 74 (seen in Figure 3) for a heating fluid, which in the illustrated example is hot water.

The sealing fluid is kept in a supply container 76 as shown in Figure 5, and is conveyed from there to the supply duct 67 of the two associated plungers 51 by means of a pump 77, which is a peristaltic pump in the illustrated embodiment, and a supply line 78. From the return ducts 68 the excessive sealing fluid, i.e. that proportion which is not discharged through the annular space 71, flows back into the container 76.

When the finished capsules whose caps C are tightly connected or locked to the associated capsule bodies are made of hard gelatine, the sealing fluid is preferably liquid elatine having a viscosity of about 200 Bloom at a temperature of about 50°C in the container 76. The heating fluid maintains the plunger at a temperature at which the temperature and the viscosity of the sealing fluid in the plunger change as little as possible with respect to the condition in the container 76.

To this end the heating fluid is maintained in a reservoir 81 at a constant temperature of about 60°C with the aid of a thermostatically controlled heater 82 and is conveyed from there by a pump 83 in continuous circulation through a heating jacket 84 surrounding the container 76, and then through supply lines 86 into the supply passages 73 and thence through the return passages 74 and a return line 87 back into the reservoir 81.

In the position illustrated in Figure 3 which the shaft 62 normally occupies under the influence of the spring 63, the sealing fluid is prevented from reaching the annular space 71, for the collar 61 forms a valve seat which the end of the shaft 62 acting as a valve member sealingly engages. As shown in Figure 3 the collar 41 provided at the lower end of the sleeve 11 has an annular frustoconical surface diverging downwardly and bearing against a complementary conical surface 88 formed on the upper part 58 of the plunger 51. Thus, the sleeve 11 and with it the cap C, are exactly centred with respect to the plunger 51. If the upper plunger 26 is now lowered from its position shown in Figure 3 to the position shown in Figure 4, it presses the cap C downwardly inside the sleeve 11, until the lower edge of the cap engages the collar 41. During this downward movement the cap C in turn urges the plunger head 66 downwardly to an extent that a gap is formed between the shaft 62 and the collar 61, while the annular space 71 is at the same time reduced in size in the axial direction. The sealing fluid flows through the constricted annular space at a relatively high velocity and is sprayed against the inner wall of the cap such that there is a ring of sealing fluid on the inner wall. The upper plunger 26 is then withdrawn upwardly and the lower plunger 51 is retracted downwardly from the sleeve 11 and thus also from the cap C.

The operational steps which follow are those that are commonly employed with machines of the described type and are therefore not described.

In the modified construction illustrated in Figure 6 numerous structural elements correspond to those illustrated in Figure 5 and therefore have been assigned the same reference numerals. Only the differences between the two constructions will be described.

In the container 76 for the sealing fluid an inner container 91 is disposed whose upper edge is above the level of the sealing fluid. In the inner container 91 a vertical plunger guide 92 is arranged, in which a plunger 93 is mounted so as to be vertically movable. As can be seen in Figure 7, the plunger 93 has at its upper end a downwardly divergent frusto-conical outer surface 94. A shaft 95 is guided so as to be vertically movable in the plunger 93, the upper end of the shaft being formed as a plunger head 96. An annular spring 97 preferably made of a helically would wire is disposed between the plunger head 96 and the frusto-conical surface 94.

The plunger is connected to the linkage 53 via the rocker 52. Movements of the rocker 52 and the plunger 93 are allowed for by a diaphragm 98 separating the sealing fluid in the inner container 91 from the sealing fluid in the outer container 76.

In its lower position illustrated in Figure 6 by solid lines, the plunger 93 is immersed totally into the sealing fluid. The pump 77 continuously conveys sealing fluid from parts of the container 76 that are located outside the inner container 91, into the inner container from below so that the sealing fluid flows upwardly past the plunger 93 until it flows over the edge of the inner container. In this manner, local differences in temperature and differences in the viscosity of the sealing fluid resulting therefrom are avoided in the region of the plunger 93. Consequently, the plunger 93 is at all times wetted with sealing fluid ready to be used when the plunger is moved upwardly out of the inner container 91 by means of the rocker 52. The majority of the sealing fluid flows back downwardly along the plunger 93 during the upward movement of the plunger out of the inner container 91, however a certain amount of the sealing fluid is retained between the helices of the annular spring 97.

During its upward movement the plunger 93 moves into a cap C, as illustrated in Figure 7, so that the plunger head 96 engages the inner wall of the cap, as shown on the left-hand side of Figure 7 at which point the annular spring 97 does not yet contact the inner wall of the cap C. When the upper plunger 26 is moved downwardly with respect to the sleeve 11 and hence also with respect to cap C, into the position illustrated on the right-hand side of Figure 7 the plunger urges the cap C downwardly, as in the embodiment illustrated in Figures 3 to 5. and the cap in turn urges the plunger head 96 downwardly with

respect to plunger 93. The plunger head 96 in turn moves the annular spring 97 on the inclined surface 94 downwardly and outwardly, and the spring is extended due to the divergence of the surface and bears against the inner wall of the cap C. The sealing fluid present between the helices of the annular spring 97 wets the inner wall of the cap C and leaves a ring of sealing fluid on the wall when the plunger 93 is lowered again.

A feature common to the two embodiments shown in Figures 3 to 5 and Figures 6 and 7 respectively is that no sealing fluid is discharged when due to a deficiency in operation, the cap C that should be fitted in the sleeve 11 is absent. In both embodiments this is achieved in that the downward stroke of the upper plunger 26 is limited with respect to the sleeve 11, by the adjustment of the thrust ring 39, so that the plunger 26, when the cap C is absent is not capable of pressing the plunger head 66 or 96 downwardly with respect to the plunger 51 or 93, to such an extent that the shaft 62 is moved away from the collar 61 serving as valve seat, or that the annular spring 97 is extended. In both of the embodiments of the invention as described it is therefore ensured that the inner wall of the sleeve 11 will not be contaminated with sealing fluid.

Claims

1. A machine for connecting capsule bodies and caps comprising at least one sleeve for receiving and retaining a cap and at least one plunger receprocable coaxially with respect to the sleeve in which the plunger has a plunger head which is axially movable with respect to the plunger and is adapted to fit within a cap, and further includes biassing means adapted to urge the plunger head in a direction which, in use, is towards the cap, the plunger head and the plunger together at least partially defining an annular space adapted to retain sealing fluid or to communicate with a supply duct for sealing fluid, the machine being constructed and arranged such that when the plunger head is urged against the interior of a cap sealing fluid is applied to the interior of the cap.

2. A machine as claimed in Claim 1 in which the plunger head is fixedly secured to a shaft guided in a bore within the plunger and acted on by a spring.

3. A machine as claimed in Claim 2 in which the shafts acts as a valve member controlling a supply duct for the sealing fluid, the supply duct extending in the plunger and being adapted to communicate with the annular space.

4. A machine as claimed in Claim 3 in which the end of the shaft acts as the valve member and co-operates with the edge of an annular collar formed at the end of the bore in the plunger which constitutes the valve seat.

5. A machine as claimed in Claim 3 or Claim 4 in which the plunger has a first return duct for excessive sealing fluid, the said return duct together with the supply duct forming part of a circulation system for the sealing fluid, the system including a pump and a heatable reservoir.

6. A machine as claimed in Claim 5 and Claim 4 in which the shaft has a second return duct communicating with the bore within the plunger adjacent the end of the shaft connected to the first return duct in the plunger at least when the shaft is in a position where the communication of the supply duct with the annular space is interrupted.

7. A machine as claimed in any one of claims 1 to 6 in which the plunger includes heating means.

8. A machine as claimed in Claim 7 in which the heating means comprises passages for the circulation of a heating fluid, the passages forming part of a circulation system which includes a pump.

9. A machine as claimed in Claim 2 in which an annular, extensible spring adapted to be wetted with sealing fluid is disposed in the annular space, the outer surface being frusto-conical so that the spring is pressed radially tutwards against the inner wall of the cap when the plunger head is urged against the interior of the cap.

10. A machine as claimed in Claim 9, in which the plunger is adapted to be moved up and down between an upper operating position and a lower rest position in which the plunger, when in its rest position, is totally immersed in a sealing fluid container.

11. A machine for connecting capsule caps and bodies substantially as herein described with reference to Figures 1 to 5 or 6 and 7 of the accompanying drawings.

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